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11 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

Laboratory data quality is determined through the assessment of the laboratory Data Quality Indicators (DQI), internal assessments, and the validation of laboratory data. Precision, accuracy, completeness, representativeness and comparability for the laboratory analyses were reviewed, calculated (where applicable) and compared to the JPG QAPP target values. A 100 % external (Third Party) laboratory data validation was performed by the Science Applications International Corporation (SAIC). The project produced acceptable results for 98.5 % of the sample analyses (see SAIC Analytical Data Validation Report in Appendix D). The report identifies 82 of 684 results or values for metals in vegetation and 59 of 2088 results or values for metals in soil as rejected data (see SAIC Analytical Data Validation Report in Appendix D).

Method audits are a subset of Fixed Laboratory Technical Systems Audits (TSAs) and consist of the auditor observing the analyst while he/she performs the analytical method on actual real world samples to ensure the analytical laboratory standing operating procedures (SOPs) are followed as required by the JPG QAPP. These types of audits are also covered under the laboratory's Quality System requirements and are required to be performed annually. Method audits are not required for this project if the laboratory can demonstrate that a method audit for the specific analytical procedure used in support of this QAPP has been performed within the last year. The following method audits were conducted to meet the above requirements:

- USACHPPM DLS SOP CAD 82, "*The Analysis of White Phosphorus in Water and Sediment*," audit conducted 26 September 2002.
- USACHPPM DLS SOP U_004.001, "*Uranium in Soil Preparation*," conducted 15 October 2002.
- USACHPPM SOP U_006.000, "*Determination of Uranium – 238 and Isotopic Uranium Ratios by ICP/MS*," conducted 10 December 2002.
- USCOE ECB Method 8330M, "*Explosives in Vegetation*," conducted 9 September 2002.

The results of the method audits and corrective actions implemented are provided in Appendix C.

All sample holding times were met except for samples SE-1, SE-2, SE-3, SE-13, and SE-17 for total volatile solids in sediment (see SAIC Analytical Data Validation Report in Appendix D for a detailed explanation of holding times).

11.1 LABORATORY DQIs

11.1.1 Laboratory Precision

Laboratory precision is assessed through the use of matrix spikes (MS) and matrix spike duplicates (MSD) and calculated as the relative percent difference (RPD) between the two samples (See JPG QAPP Section 1.8.5). The average RPD for each set of MS and MSD samples in all sample delivery groups were calculated, and the values are provided in Tables 11-1 through 11-3. The average RPD for the MS/MSD for each analyte was below the JPG QAPP target RPD except for chromium in sediment. A detailed discussion of metals acceptability for precision is provided in the SAIC third party data validation report provided in Appendix D.

TABLE 11-1. RESULTS OF LABORATORY PRECISION, ACCURACY AND COMPLETENESS REVIEW FOR GROUND WATER AND SOIL

PARAMETER	Ground Water						Soil					
	Precision (RPD)		Accuracy (%R)		Completeness (%)		Precision (RPD)		Accuracy (%R)		Completeness (%)	
	Average	Target	Average	Target	Actual	Target	Average	Target	Average	Target	Actual	Target
Antimony - Sb	1.5	<30	103	70-130	100	95.0	3.9	<50	58.9	50-150	97.2	95.0
Arsenic - As	.91	<30	95	70-130	100	95.0	1.5	<50	106	50-150	100	95.0
Barium - Ba	1.3	<30	121	70-130	100	95.0	3.0	<50	118	50-150	100	95.0
Cadmium - Cd	.76	<30	70	70-130	100	95.0	1.0	<50	107	50-150	100	95.0
Calcium - Ca	2.3	<30	91	70-130	100	95.0	N/A	N/A	N/A	N/A	N/A	N/A
Chromium - Cr	1.3	<30	101	70-130	100	95.0	1.2	<50	107	50-150	100	95.0
Copper - Cu	3.4	<30	87	70-130	100	95.0	2.2	<50	105	50-150	100	95.0
Lead - Pb	4.5	<30	92	70-130	100	95.0	1.6	<50	108	50-150	100	95.0
Molybdenum - Mo	1.3	<30	100	70-130	100	95.0	1.3	<50	109	50-150	100	95.0
Manganese - Mn	1.8	<30	112	70-130	100	95.0	11	<50	129	50-150	100	95.0
Mercury - Hg	.32	<30	101	70-130	100	95.0	1.0	<50	101	50-150	100	95.0
Nickel - Ni	2.6	<30	98	70-130	100	95.0	1.3	<50	106	50-150	100	95.0
Silver - Ag	1.4	<30	94	70-130	100	95.0	1.1	<50	113	50-150	100	95.0
Uranium - U	3.1	<30	101	70-130	100	95.0	5.2	<50	109	50-150	100	95.0
Vanadium - V	2.1	<30	110	70-130	100	95.0	1.8	<50	115	50-150	100	95.0
Zinc - Zn	4.0	<30	106	70-130	100	95.0	N/A	N/A	N/A	N/A	N/A	N/A
Perchlorate	5.4	<30	114	70-130	100	95.0	1.9	<50	96.5	50-150	100	95.0
HMX	4.3	<30	98	70-130	100	95.0	4.9	<50	90.8	50-150	100	95.0
RDX	0	<30	100	70-130	100	95.0	2.8	<50	80.5	50-150	100	95.0
1,3,5-TNB	0	<30	96	70-130	100	95.0	2.0	<50	76.5	50-150	100	95.0
1,3-DNB	52.9	<30	99	70-130	100	95.0	1.6	<50	86.2	50-150	100	95.0
Tetryl	5.3	<30	101	70-130	100	95.0	13	<50	104	50-150	100	95.0
NB	4.3	<30	96	70-130	100	95.0	1.4	<50	94.0	50-150	100	95.0
2,4,6-TNT	0	<30	100	70-130	100	95.0	6.0	<50	89.7	50-150	100	95.0
4AM26DNT	8.7	<30	92	70-130	100	95.0	11	<50	58.1	50-150	100	95.0
2AM46DNT	0	<30	100	70-130	100	95.0	4.2	<50	80.6	50-150	100	95.0
2,4-DNT	0	<30	100	70-130	100	95.0	2.2	<50	89.9	50-150	100	95.0
2,6-DNT	3.9	<30	99	70-130	100	95.0	1.7	<50	91.9	50-150	100	95.0

PARAMETER	Ground Water						Soil					
	Precision (RPD)		Accuracy (%R)		Completeness (%)		Precision (RPD)		Accuracy (%R)		Completeness (%)	
	Average	Target	Average	Target	Actual	Target	Average	Target	Average	Target	Actual	Target
2-NT	1.4	<30	101	70-130	100	95.0	2.4	<50	105	50-150	100	95.0
3-NT	1.4	<30	99	70-130	100	95.0	2.3	<50	98.9	50-150	100	95.0
4-NT	0	<30	99	70-130	100	95.0	1.7	<50	96.8	50-150	100	95.0
Nitroglycerin	12	<30	96	70-130	100	95.0	4.7	<50	99.4	50-150	100	95.0
Total Organic Carbon – TOC	2.0	<30	101	70-130	100	95.0	N/A	N/A	N/A	N/A	N/A	N/A
Total Dissolved Solids - TDS	1.9	<30	100	70-130	100	95.0	N/A	N/A	N/A	N/A	N/A	N/A

N/A – Not Applicable in this matrix.

TABLE 11-2. RESULTS OF LABORATORY PRECISION, ACCURACY AND COMPLETENESS REVIEW FOR SURFACE WATER AND SEDIMENT

PARAMETER	Surface Water						Sediment					
	Precision (RPD)		Accuracy (%R)		Completeness (%)		Precision (RPD)		Accuracy (%R)		Completeness (%)	
	Average	Target	Average	Target	Actual	Target	Average	Target	Average	Target	Actual	Target
Antimony - Sb	13	<30	106	70-130	100	95.0	14	<50	105	50-150	100	95.0
Arsenic - As	4.1	<30	106	70-130	100	95.0	3.0	<50	106	50-150	100	95.0
Barium - Ba	1.0	<30	101	70-130	100	95.0	6.8	<50	102	50-150	100	95.0
Calcium - Ca	22.8	<30	154	70-130	100	95.0	N/A	N/A	N/A	N/A	N/A	N/A
Cadmium - Cd	4.2	<30	103	70-130	100	95.0	11	<50	99	50-150	100	95.0
Chromium - Cr	8.0	<30	98.8	70-130	100	95.0	62	<50	162	50-150	100	95.0
Copper - Cu	4.4	<30	96.8	70-130	100	95.0	6.5	<50	102	50-150	100	95.0
Lead - Pb	5.7	<30	106	70-130	100	95.0	3.5	<50	103	50-150	100	95.0
Magnesium - Mg	3.9	<30	878	70-130	100	95.0	N/A	N/A	N/A	N/A	N/A	N/A
Molybdenum - Mo	3.5	<30	102	70-130	100	95.0	14	<50	108	50-150	100	95.0
Manganese - Mn	1.8	<30	101	70-130	100	95.0	18	<50	79	50-150	100	95.0
Mercury - Hg	2.7	<30	105	70-130	100	95.0	19	<50	99	50-150	100	95.0
Nickel - Ni	3.0	<30	93.6	70-130	100	95.0	16	<50	105	50-150	100	95.0
Silver - Ag	20	<30	93.1	70-130	100	95.0	5.8	<50	100	50-150	100	95.0
Uranium - U	1.5	<30	111	70-130	100	95.0	29	<50	107	50-150	100	95.0
Vanadium - V	2.1	<30	103	70-130	100	95.0	19	<50	103	50-150	100	95.0
Zinc - Zn	14	<30	101	70-130	100	95.0	2.5	<50	105	50-150	100	95.0
Perchlorate	3.6	<30	106	70-130	100	95.0	4.0	<50	101	50-150	100	95.0
HMX	1.0	<30	98.8	70-130	100	95.0	7.3	<50	127	50-150	100	95.0
RDX	8.4	<30	100	70-130	100	95.0	3.8	<50	107	50-150	100	95.0
1,3,5-TNB	12	<30	102	70-130	100	95.0	0	<50	97	50-150	100	95.0
1,3-DNB	2.1	<30	98.6	70-130	100	95.0	1.1	<50	94	50-150	100	95.0
Tetryl	6.8	<30	103	70-130	100	95.0	11	<50	84	50-150	100	95.0
NB	6.1	<30	104	70-130	100	95.0	0	<50	122	50-150	100	95.0
2,4,6-TNT	12	<30	102	70-130	100	95.0	1.0	<50	99	50-150	100	95.0
4AM26DNT	4.4	<30	98.4	70-130	100	95.0	3.3	<50	89	50-150	100	95.0

PARAMETER	Surface Water						Sediment					
	Precision (RPD)		Accuracy (%R)		Completeness (%)		Precision (RPD)		Accuracy (%R)		Completeness (%)	
	Average	Target	Average	Target	Actual	Target	Average	Target	Average	Target	Actual	Target
2AM46DNT	4.0	<30	102	70-130	100	95.0	1.0	<50	97	50-150	100	95.0
2,4-DNT	3.1	<30	101	70-130	100	95.0	1.0	<50	97	50-150	100	95.0
2,6-DNT	2.5	<30	101	70-130	100	95.0	2.0	<50	98	50-150	100	95.0
2-NT	4.8	<30	101	70-130	100	95.0	2.0	<50	97	50-150	100	95.0
3-NT	3.3	<30	104	70-130	100	95.0	1.0	<50	98	50-150	100	95.0
4-NT	4.2	<30	100	70-130	100	95.0	2.1	<50	98	50-150	100	95.0
Nitroglycerin	9.0	<30	96	70-130	100	95.0	1.7	<50	122	50-150	100	95.0
White Phosphorus	12	<30	101	70-130	100	95	3.8	<50	108	50-150	100	95.0
Total Volatile Solids - TVS	N/A	N/A	N/A	N/A	N/A	N/A	5.0	<50	101	50-150	100	100

N/A – Not Applicable in this matrix.

*Bolded/shaded values are outside of the target acceptance criteria.

TABLE 11-3 RESULTS OF LABORATORY PRECISION, ACCURACY AND COMPLETENESS REVIEW FOR VEGETATION

PARAMETER	Vegetation					
	Precision (RPD)		Accuracy (%R)		Completeness (%)	
	Average	Target	Average	Target	Actual	Target
Antimony - Sb	3.5	<50	85.6	50-150	100	95.0
Arsenic - As	.93	<50	86.8	50-150	100	95.0
Barium - Ba	1.5	<50	97.9	50-150	100	95.0
Cadmium - Cd	.57	<50	87.2	50-150	100	95.0
Chromium - Cr	.59	<50	101	50-150	100	95.0
Copper - Cu	.91	<50	95.7	50-150	100	95.0
Lead - Pb	.25	<50	96.3	50-150	100	95.0
Molybdenum - Mo	.49	<50	98.9	50-150	100	95.0
Manganese - Mn	4.2	<50	100	50-150	100	95.0
Mercury - Hg	2.1	<50	72.4	50-150	100	95.0
Nickel - Ni	.63	<50	97.3	50-150	100	95.0
Silver - Ag	16	<50	78.4	50-150	91.8	95.0
Vanadium - V	.80	<50	101	50-150	100	95.0
HMX	9.5	<50	64.5	50-150	100	95.0
RDX	12	<50	37.8	50-150	100	95.0
1,3,5-TNB	33	<50	58.6	50-150	100	95.0
1,3-DNB	9.5	<50	54.4	50-150	100	95.0
Tetryl	11	<50	80.7	50-150	100	95.0
NB	9.0	<50	62.8	50-150	100	95.0
2,4,6-TNT	8.0	<50	75.2	50-150	100	95.0
4AM26DNT	6.0	<50	78.8	50-150	100	95.0
2AM46DNT	9.0	<50	58.9	50-150	100	95.0
2,4-DNT	2.5	<50	71.9	50-150	100	95.0
2,6-DNT	24	<50	97.2	50-150	100	95.0
2-NT	7.5	<50	81.4	50-150	100	95.0
3-NT	19	<50	65.7	50-150	100	95.0
4-NT	30	<50	67.5	50-150	100	95.0
Nitroglycerin	NA	<50	NA	50-150	NA	95.0

N/A – Not Applicable in this matrix.

*Bolded/shaded values are outside of the target acceptance criteria.

11.1.2 Laboratory Accuracy

Laboratory accuracy is assessed through the use of matrix spikes, laboratory control spikes, and/or surrogates and calculated as the percent recovery (See JPG QAPP Section 1.8.5). The average percent recovery for each set of QC samples in all sample delivery groups was calculated and the values are provided in Tables 11-1 through 11.3. The average percent recovery for all analytes were within the JPG QAPP target range except RDX in vegetation, magnesium and calcium in surface water, and chromium in sediment. A detailed discussion of metals acceptability for accuracy is provided in the Battelle QA/QC Summary for metals in sediment (see Appendix B) and in the SAIC third party data validation report provided in Appendix D. The limits for accuracy for RDX in vegetation (50-150) identified in the JPG QAPP were estimated due to the lack of completed method detection limit (MDL) studies at the time the document was developed (See Table 11-3). The values for percent recovery for RDX were within the method acceptance limits of 17-48% recovery. The method acceptance limits of 17-48% recovery were used for the third party data validation (See Appendix D). All other explosives compounds were within the method QC acceptance limits and the JPG QAPP target limits.

11.1.3 Laboratory Completeness

Laboratory completeness is a comparison of the amount of valid data measured versus the total amount of samples collected. All QAPP target values for laboratory completeness were exceeded except silver in vegetation (see Table 11-3). A detailed discussion of metals acceptability for completeness is provided in the SAIC third party data validation report provided in Appendix D. Completeness values are provided in Tables 11-1 through 11-3. Nitroglycerin (NG) was not analyzed for in vegetation samples due to the detection of NG in the soil samples being very limited. Therefore, we believe the lack of NG analysis in vegetation did not affect the overall results presented in the report.

11.1.4 Laboratory Representativeness and Comparability

Laboratory representativeness and comparability are assessed by ensuring that the proper analytical methods were used, by meeting the sample holding times, and analyzing and assessing field duplicate samples. The appropriate DLS personnel reviewed all data packages from contract and in-house laboratories and the methodology used was found to be identical or nearly identical to analytical methodology required by the JPG QAPP. The SAIC analytical data validation report discusses any missed sample holding times and their effect on the validity of the data (See Appendix D).

Laboratory representativeness is calculated as the RPD between the field duplicate samples (See JPG QAPP Section 1.8.5). The RPD between the field duplicate samples is also a measure of sampling precision. The sampling precision tables showing the RPD values between duplicate samples are provided in Sections 6 for ground waters, 7 for soils, and 10 for vegetation.

11.2 INTERNAL AUDIT AND ASSESSMENT REPORTS

All internal audit and assessment reports are provided in Appendix C.

11.3 THIRD PARTY DATA VALIDATION

The SAIC performed a data validation on 100% of the analytical data. The results of the data validation are provided in Appendix D.